



The establishment of the Exclusive Economic Zone (EEZ) in 1983 by Presidential Proclamation opened for natural resource exploration a vast offshore frontier area contiguous to the United States and its territories. The EEZ extends from the seaward limit of state waters (3 nautical miles from shore) to 200 nautical miles offshore, and it includes the continental shelves. Within the context of the EEZ natural resource assessment effort, the purpose of this study is to delineate, on a regional basis, the potential for heavy-mineral placers on the U.S. Continental Shelf in the western and northern Gulf of Mexico from the United States-Mexico border to the Alabama-Louisiana state line. This map is intended to serve as a general guide for placer exploration. It shows favorable sea-floor areas for placer occurrence in water depths ranging from 0 to 100 fathoms (600 ft). The map can be used as a guide for focusing costly exploratory efforts, such as coring operations and geophysical surveys.

The potential economic value of heavy-mineral placer concentration on the U.S. Continental Shelf is a function of both geologic and economic variables. Geologic variables include the composition and concentration of the heavy-mineral assemblages and their environment of deposition, depositional mechanisms, and the current world market price of extracted metals, as well as the cost of mining, processing, and marketing the metals. These economic factors, in turn, are tempered by the nation's socio-political climate, which determines its need for specific mineral resources at any given time.

This study divides the sea floor of the western and northern Gulf continental shelf into areas having low, moderate, and high potential for heavy-mineral placers. This division is based entirely on geologic criteria rather than on socio-economic or technological factors such as water depth or distance from processing and marketing areas.

One of the most basic criteria for differentiating areas of placer potential is the texture of the surficial sediment. Heavy-mineral placers are products of sedimentation in relatively high-energy environments. The residual deposits formed in high-energy environments are of relatively coarse grained sand and well-sorted in the light-colored fine sand facies that are well-sorted in high-energy environments (Bettencourt, 1983) with coarser and higher density heavy-mineral particles concentrated in placers. In contrast, clay- and silt- and silty sediments (mud) are the winnowed component of the hydraulic fractionation process, and they are generally deposited from suspension in lower energy environments. Although concentrations of ultra-fine heavy minerals can accumulate in such low-energy environments, present mining and beneficiation techniques generally are not capable of economically recovering heavy minerals in the less than 50 μ m particle-size range (Rouse, 1979). The probability of placer resource occurrence increases as the sand/silt/clay ratio of the sea-floor sediment increases. Sea-floor areas composed of clean sand and gravel have the highest potential for heavy-mineral placers whereas areas composed of mud have the lowest potential; areas composed of muddy sand or gravel have moderate potential.

In addition to texture, the gross mineralogy of the sea-floor sediment's light-colored fraction is another indicator of placer potential. The major distinction is between siliciclastic and carbonate sea-floor deposits. The siliciclastic facies is the main source of heavy-mineral placers, whereas the potential for placer occurrence in a carbonate facies is very low.

A second criterion for evaluating heavy-mineral placer potential on the modern sea floor is the post-turbidity history of the sea-floor sediment. As a result of glacio-tectonic sea-level fluctuations, the continental shelves were alternately submerged and exposed; they were extensively modified by tectonic erosion and deposition processes, which have an influence on where placers may be found. Sea-floor sediment areas that have a tectonic history favorable for placer potential include favorable sites for placer occurrence.

The origin of marine placers is not completely understood to fully develop reliable offshore exploration models. However, there are several major types of placers that can be used in an exploratory program. More than three major types of placers have been identified: (1) appropriate heavy-mineral source rocks, (2) a favorable mineralogy, and (3) an appropriate depositional environment. In relation to the latter, the interpretation of the tectonic history of sea-floor sediment is critical to the evaluation of placer potential.

In the most suitable heavy-mineral placers, the heavy minerals are igneous and metamorphic rocks. In placers of igneous origin, the heavy minerals are relatively poor sources of valuable heavy minerals. The most important sources of heavy minerals in heavy-mineral placers are igneous and metamorphic rocks, which are relatively poor sources of valuable heavy minerals. The most important sources of heavy minerals in heavy-mineral placers are igneous and metamorphic rocks, which are relatively poor sources of valuable heavy minerals.

tourmaline; these species are commonly multicystic minerals derived from reworked igneous and metamorphic rocks. The formation of marine placers is dependent upon the presence of suitable offshore bedrock capable of providing economically significant quantities of heavy minerals. Some of the best sites were economic placers have been mined (Derry and Rouse, 1980). However, the absence of offshore placer sites does not necessarily negate the possibility of offshore placers occurring. As noted in studies of heavy minerals on the U.S. Atlantic continental shelf (Groat and Sencer, 1985), heavy minerals have been found in offshore areas adjacent to the continental shelf. The absence of offshore placers should not be used to exclude adjacent offshore sectors from exploration.

A sediment history favorable for placer occurrence includes the development of a transport conduit and concentration and deposition in economic quantities. Such concentration and deposition of heavy minerals generally occur within high-energy hydraulic regimes associated with fluvial or littoral environments. During flow, geomorphic features in these high-energy environments may form, and they may indicate favorable sites for placers. Evidence of surficial geomorphic expression, such as present sea-floor ridges, can be used as positive evidence suggesting placer occurrence; their absence should not be used to indicate prospective sites for further exploration. In addition to sea-floor sediment composition and physiography, areas were delineated on the map where published information on heavy-mineral compositions is available (see table 1), which further contributes to an evaluation of placer potential.

The western and northern Gulf continental shelf is a tectonically active province. The geologic province adjacent to the continental shelf is the Gulf Coastal Plain, which is composed of sedimentary rocks of Mesozoic and Cenozoic age. The drainage basins of most coastal plain rivers are localized within these sedimentary rocks, which could be the source of marine multicystic heavy minerals. Adjacent to the Texas continental shelf, the only Texas Coastal Plain rivers that have significant sediment transport are the Rio Grande, Colorado River, and Rio Grande. The Rio Grande traverses Precambrian to Cenozoic rocks and metamorphic rocks from the Rio Grande west of Texas and northward. The Colorado River traverses some Precambrian to Cenozoic rocks and metamorphic rocks from the Rio Grande and Colorado River to the Gulf of Mexico. The Rio Grande and Colorado River appear to be the most important sources for the transport of heavy minerals into the Texas continental shelf.

Texan continental shelf has been discussed by Shideler and Flores (1976), Van Andel (1960), and Van Andel and Dolé (1960). In general, regional variations in composition were characterized by a suite composed dominantly of igneous minerals, granite, and gneiss. In contrast, a northern Texas continental shelf is characterized by a suite composed dominantly of igneous minerals, granite, and gneiss. In contrast, a northern Texas continental shelf is characterized by a suite composed dominantly of igneous minerals, granite, and gneiss. In contrast, a northern Texas continental shelf is characterized by a suite composed dominantly of igneous minerals, granite, and gneiss.

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HEAVY-MINERAL PLACER POTENTIAL MAP OF THE U.S. CONTINENTAL SHELF, WESTERN AND NORTHERN GULF OF MEXICO

By
Gerald L. Shideler
1988